

15 April 1963

MEMORANDUM FOR: Assistant for Plans and Development

THROUGH : Executive Secretary, IDC

SUBJECT : Staff Study - Development of a New Measuring System

1. PROBLEM:

To develop a reliable high accuracy measuring technique for large format film comparators.

2. FACTS:

At present almost all large format ($9\frac{1}{2}'' \times 9\frac{1}{2}''$ or larger) comparators rely on either a precision lead screw or the [] Moire Fringe Techniques. Other measuring techniques have been tried from time to time but none have proven successful thus far. Of particular interest here is the interferometer which has an accuracy greater than those systems mentioned above and performs well on small comparators, but has a reduced performance factor on large comparators due to vibration sensitivity over long distances.

[] has been manufacturing for some time angular sensing discs with a resolution of 2^{19} or 524, 288 bits per revolution and are presently working on one capable of 2^{21} or 2,097, 152 bits per revolution. The same principles involved in the angular disc can be applied to a linear travel. [] trademark for their system is Phasolver.

3. DISCUSSION OF THE FACTS:

In selecting a digitizing system for a large comparator several of the major factors for consideration are reliability, speed, and accuracy. All factors must also be evaluated in terms of total system performance.

The reliability of the lead screw is unquestionably the highest, but it is dependent upon a readout device and hence its reliability is that of the readout. The [] Moire Fringe is subject to extreme unreliability based on our experience with the RIC/1's now delivered to NPIC and the DEMP which is to be delivered shortly. Of importance in reliability is that the [] system is controlled by a British firm which has proven to be extremely difficult to do business with and has made no attempt to improve customer relations thus far.

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While it is impossible to attach a reliability factor to the linear Phasolver at this time, the angular Phasolver units in use have acceptable reliability and the [] is placing considerable company effort on improving their reliability. The satellite tracking antenna applications made of the angular Phasolver thus far has proven their reliability.

The speed varies considerably between the three types. The lead screw is the slowest with almost no chance of improvement. The Moire Fringe system is basically limited to the counting rate of the electronics. At present the basic [] circuitry is capable of counting at a 20KC rate but this can be improved by about a factor of 5 by replacing most of [] circuitry. The linear Phasolver has no limitations as to counting speed since it is a unique positioning or non ambiguous system. This has an additional advantage in that momentary power failure cannot affect the true count. One possibility here is that power could be turned off over night and work could proceed the next day if a good film clamping system was devised.

The accuracy of the lead screw thus far has been limited to a ± 1 micron least count with a ± 4 to 5 micron accuracy over a $9\frac{1}{2}" \times 9\frac{1}{2}"$ stage. The accuracy of the [] system is approximately the same. The expected accuracy of the Phasolver system based on their angular phasolver is $\pm \frac{1}{4}$ microns least count with ± 1 micron over $9\frac{1}{2}" \times 9\frac{1}{2}"$.

A summary of the advantages of the Phasolver are:

1. There is no count loss due to power failure.
2. There is no limitation as to speed of movement as far as the digitizing system.
3. There is no accuracy loss due to wear or backlash such as is present in the lead screw.
4. There is no limitation as to the length of measurements.
5. The Phasolver offers the potential of greater accuracy than either the lead screw or Moire Fringe.

While no direct usable equipment would result from the two phase program as presented in the [] proposal, a new measuring technique would be made available for incorporating into future comparator development. This is of particular importance since most major comparator manufacturers have adopted the [] system because of its speed, freedom of backlash, and wear qualities. To date all manufacturers, with whom the [] problem has been discussed, are looking for a replacement system.

4. CONCLUSIONS:

All information available to date indicates that applying the Phasolver principal to linear motion will produce a superior method of film measurement than any we now have. An additional benefit is that it will be entirely produced within this country and therefore can be more closely monitored than []

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5. RECOMMENDATIONS:

It is recommended that a CPTF contract be negotiated with the [redacted] to develop a linear Phaseolver system as outlined in their proposal #ES 20793. To restrict Agency interest in this development the contract should be made on a [redacted] basis.



Development Branch, PADS

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